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AGRICULTURAL RESEARCH IN CHINA*

By H. K. HAYES

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DURING the summer of 1936 the writer visited many of the agricultural research institutions in Central and Northern China and observed the nature and extent of the investigations under way. From published papers in other countries which refer to work in China, such as the yearbook for 1936 of the United States Department of Agriculture which so adequately has summarized plant and animal breeding in the United States, it is apparent that there is little appreciation of the extent and nature of similar work in China. This is not strange, as until very recently there have been no adequate summaries in English. As the writer has been associated with leaders in agricultural research, affiliated with the Central Government of China or with various provincial departments and agricultural colleges, it seemed possible to make a survey that would give some idea of the nature and development of agricultural research in China in recent years. Data for this survey have been collected through correspondence with workers in various provinces and from members of the National Agricultural Research Bureau[1] in Nanking who are in touch with special phases of research throughout China. A summary by Director K. S. Sie,[2] of the National Agricultural Research Bureau, in the Chinese Year Book for 1935–36 has been of special value. The writer is greatly indebted to those who have so kindly made this information available.[3]

* Address of the vice-president and chairman of the Section on Agriculture, American Association for the Advancement of Science, Atlantic City, December, 1936.

[1] The Nat. Agr. Res. Bur. Ministry of Industry. Miscellaneous Pub. No. 1. 1934.

[2] K. S. Sie, "The Chinese Year Book," pp. 731–768. 1935–36.

[3] The writer appreciates the helpful suggestions of the following members of the National Agricultural Research Bureau and of the National Rice and Wheat Improvement Institute: K. S. Sie, T. H. Chien, L. F. Chao, T. H. Shen (see Proceedings 5th Pacific Science Congress, pp. 573–579, 1933, Univ. of Toronto Press, and "A Coordinated Program of Wheat Breeding in China," in press, 1936), C. L. Pan, F. C. Woo, P. T. Sun, C. C. Kwan, S. C. Cheng, H. Tai, N. F. Chang, W. S. Tong and K. Ling. Paper

Before discussing various lines of research and experimental work under way it seems desirable to make a few observations regarding farming in China.

Some Farm Practices in China

While agricultural research in China is of rather recent development, the art of farming has been well worked out through centuries of trial and error.

In most regions the farmers live in villages and a farm consists of non-contiguous plots, in unfenced fields, the plots of a single farm often being located at some distance from each other. The size of farm is small, and Buck[4] states "that for China as a whole the size of farm is probably well under five acres."

Most of the farm work is done by hand labor, including planting, cultivating, harvesting, threshing and in some provinces carrying the crop to market. In East Central China, for example, the crop from the field usually is carried to the farm home by means of a carrying pole over the shoulders; and the threshed grain may be transported to market by the same means. In the north farm products are carried by donkeys, horses or mules. In the vicinity of large cities the streets are often lined in the early morning with farmers carrying their produce to market. The amount of human labor used in the farm operations can hardly be appreciated by any one who has not observed the conditions.

The utilization of all forms of organic waste products as fertilizers has led to a permanent system of conserving soil fertility. Farm manures and some other forms of organic waste products are generally composted before being returned to the soil. In East Central China, where rice is the main crop, pond and canal mud often is applied to the fields in large quantities, while ashes from fuel are an important fertilizer also. Near the large villages the use of "night soil" has led to excellent crop yields, although those fields that are at some distance from the village frequently appear deficient in productivity.

Satisfactory systems of crop sequence have been developed and are in common use. While more intensive methods are used in China than in the United States, the yields of wheat, on the average, according to Buck, are about the same in both countries, while corn and cotton yields are greater in the United States than in China. Rice yields are approximately 50 per cent. greater in China than in the United States. This comparison is somewhat misleading, as the growing of two or more crops per year in China is a common practice where seasonal conditions permit. Thus in Shantung Province in the flue-cured tobacco region a common practice is to grow winter wheat and tobacco the same year on the same land, the tobacco being transplanted after the wheat is harvested. This system of double cropping is an interesting one, the crops being used varying widely according to local and seasonal conditions.

A few of the better systems described by Buck give an idea of methods that are common in several localities (see Table 1).

TABLE 1

Province	Kind of land	Year	Winter and spring crops	Summer crops
Anhwei	Low	1st	Barley	Soybeans
	"	2nd	Wheat and field peas	Sesame or soybeans
	High	1st	Wheat	Soybeans
	"	2nd	"	Sesame
	"	3rd	Kaoliang	
Kiangsu	Paddy	1st	*Astragalus sinensis*	Rice
	"	"	Wheat	"
	Low	"	Barley	"
	"	2nd	Field peas or broad beans	"
	High	1st	Wheat	Soybeans
	"	2nd	Wheat or barley	Sweet potatoes
	"	3rd	Field peas or broad beans	Corn and soybeans

A particularly intensive system noted in one section of Anhwei Province consisted of winter wheat, followed by rice. A week or two before the rice was harvested soybeans were sown broadcast in the rice fields, making three crops per year. In most of these illustrations a legume appears rather frequently in the rotations.

Interplanting of crops is a common practice. These consist, in some cases, of a legume grown in association with a non-legume. Examples are wheat and field peas used as a winter crop in one of the rotations, while barley and broad beans are grown frequently in alternate narrow plots. Early and late rice are handled in the same way, some farmers believing that larger yields are obtained than by growing either early or late rice alone.

Fuel supply for both farm and city population consists to a considerable extent of crop plants. Thus the stalks of corn and kaoliang are used extensively for fuel. Coarse grass and weeds in waste areas are cut and dried for fuel. It is a common practice in some sections of the North to harvest wheat and kaoliang plants by pulling them, using the roots as well as the stalks for fuel. These practices, which are common in the North, have reduced the organic content and humus of the soil; and while it is appreciated that this is undesirable, there is no other available supply of fuel for cooking and heating.

Agricultural Colleges in China[5]

Agricultural research depends in general on at least two main factors. First, there must be an appreci-

No. 348 of the Miscellaneous Journal Series, Minnesota Experiment Station.

[4] John Lossing Buck, "Chinese Farm Economy." The University of Nanking. 1930.

[5] S. C. Wang, "The Chinese Year Book," pp. 456-532, 1935-36.

tion of the value of such research and facilities must be furnished for conducting the research. Second, there must be a group of trained men available for carrying on the research. It may be well, therefore, to make a summary of the number of agricultural colleges in China and of the student population and to speak briefly regarding advanced training.

According to the report of the Minister of Education, there were 1,683 graduates in agriculture and forestry in 1933–34 from universities, colleges and technical schools of college grade. These are listed in Table 2.

TABLE 2

Name	Location	Auspices
National Central University	Nanking	Provincial
National University of Peiping	Peiping	"
University of Chekiang	Hangchow	"
Sun Yatsen University	Canton	"
National Wu-Han University	Wuchang	"
National University of Szechuan	Chengtu	"
University of Kwangsi	Wuchow	"
University of Honan	Kaifeng	"
University of Nanking	Nanking	Private
Lingnan University	Canton	"
Fukien Christian University	Foochow	"
Nantung College	Nantung	"
National Northwestern College of Agriculture and Forestry	Wukung	National
National Technical School of Veterinary Science	Shanghai	"
Hopei Provincial College of Agriculture	Paoting	Provincial
College of Education, Agr. Dept.	Wusih	"
Tech. School of Agr. of Kiangsi	Nanchang	"
Tech. School of Agr. of Shansi	Taiyuan	"
Inst. of Kansu Junior College of Agriculture	Langchow	"

Of this list of 19 institutions, 7 receive mainly provincial support, 8 receive support from the National Government, and 4 are privately supported.

At present there are only a few institutions that give opportunity for graduate work. These are: Sun Yatsen University, that offers graduate work in agricultural chemistry and in agricultural botany; Central University, with graduate work in plant breeding; and the University of Nanking, with graduate work in agricultural economics. The number of graduate students at these various institutions is very small. For this reason most persons engaged in agricultural research in China must obtain their graduate training in foreign countries. This is expensive and without doubt has greatly limited the number of men taking graduate training. During 1929–34, according to the report of the Minister of Education, 207 Chinese students went abroad for graduate study in agriculture and forestry. It seems very probable that, with the rapid increase in agricultural research in China in recent years, there will be also a great increase in graduate training and that this will lead to the development of graduate work in those colleges and universities in China that are best fitted to give such instruction.

The Development of Agricultural Research in China

One indication of the interest in agricultural research is the development in recent years of extensive work under the National Government. Important institutions under the Ministry of Industry include the National Agricultural Research Bureau in 1931 and the National Rice and Wheat Improvement Institute, organized in 1935. The Cotton Improvement Institute was organized in 1934 under the National Economic Council. These three institutions are located about five miles east of Nanking, where adequate buildings and land have been made available. The Division of Agricultural Economics of the National Agricultural Research Bureau made a survey of the experimental work in agriculture in 1933, including institutions under national, provincial and other auspices. While data were not secured for all provinces rather accurate data were obtained for several provinces. These data consisted of the nature of the work, the date of organization and the number of technical workers. The summary given here does not include the staff of those institutions engaged primarily in teaching. The sort of data obtained may be illustrated by the following examples. The cotton experiment station of Nantung College was organized in 1932 and has a technical staff of 13, and the Provincial Wheat Station at Huschow was organized in 1917 and has a technical staff of 9.

The data presented in Table 3 are summarized by periods for the provinces of Kiangsu, Chekiang and Shantung.

TABLE 3

NUMBER OF RESEARCH STATIONS CLASSIFIED ACCORDING TO THE DATE THE WORK WAS INITIATED AND TOTAL NUMBER OF RESEARCH WORKERS (DATA COLLECTED IN 1933)

Province	Class for date of organization					No. of tech. workers
	Before 1915	1915–24	1925–30	Since 1930	Total	
Kiangsu	2	9	4	8	23	148
Chekiang		2	3	2	7	128
Shantung	1	4	1	3	9	60
Total	**3**	**15**	**8**	**13**	**39**	**336**

Of a total of 39 such research institutions in these three provinces, 13 or nearly one third have been organized during the last six-year period. These data, while not complete for all work organized since 1933, are sufficiently accurate to give a clear picture of the interest to-day in China in research and experimentation, which has as its aim the development of greater efficiency in agriculture.

The extent and nature of agricultural research in China will be discussed by summarizing briefly research in particular fields, including crop improvement, soils and fertilizers, plant pathology, entomology, horticulture, forestry, animal husbandry and veterinary science, and sericulture.

Crop Improvement: The breeding of improved varieties of crop plants and their distribution to farmers in China is without doubt the best developed of any line of agricultural work. This is due partly

to the organization in recent years of the National Rice and Wheat Improvement Institute, under the Ministry of Industry, and the Cotton Improvement Institute of the National Economic Council. For wheat, rice and cotton these national institutes are developing cooperation with various provincial institutions. Special training schools for technical workers have been held during the winter months, under the auspices of these institutions and the National Agricultural Research Bureau, which have given admirable opportunity for the development of coordination in research.

Recently the improvement of wheat in China has been placed on a coordinated basis through cooperation between the various agencies interested in wheat improvement. Cooperative regional trials, free exchange of materials and nation-wide nurseries consisting of the more important foreign and native varieties have been planned. The breeding for disease resistance is an important feature of this cooperative program. Similar programs are being organized for improvement work with rice, cotton, sweet and Irish potatoes.

The University of Nanking has had a great influence in the development of crop improvement in China. A project first initiated by Dean John H. Reisner, of the College of Agriculture of Nanking University, was enlarged in 1924 through cooperation between the University of Nanking, Cornell University and the International Education Board. Members of the staff in plant breeding of Cornell University directed the work and did much to create a nation-wide interest in China in crop improvement.

During the last summer the writer visited many plant breeding stations in Central and Northern China and was impressed with the large proportion of technical workers in plant breeding in these sections who are graduates of the University of Nanking. A recent report of the improvement project of the University of Nanking,[6] that has been extended to include cooperation with nine provinces and the National Government, describes three improved varieties of wheat, Nanking 2905, Kaifeng 124 and Nanhsuchow 61, an improved variety of barley called Kaifeng 313, Nanksoy 332 soybeans and an improved variety of native cotton called Million Dollar. Each of these varieties appears to be a great improvement in the section in which it is adapted over the native varieties now grown. These and other improved varieties are being increased rapidly.

Workers at Central University have been leaders in cotton and rice improvement; and, through cooperation between Central University and other institutions, several valuable varieties of cotton have been introduced from America and are being grown widely in China.

A partial picture of the extent of crop improvement work in China can be gained by listing the number of experiment stations working on crop breeding in China, as given by Sie, and the crops being worked with. These consist of 56 stations that are breeding cotton; 48, wheat; 38, rice; 15, millet; 17, kaoliang; 17, soybeans; 16, corn; and 37, miscellaneous crops. Extensive studies with tea, including tea improvement, are being carried on in Southern and Central China. From statistics gathered from experiment station workers in various provinces, it seems safe to conclude that there are from 5 to 20 project leaders in most of the provinces that are giving their entire time to studies of crop breeding. Each of these leaders has an average of 2 or 3 assistants, approximately half of these being graduates of agricultural colleges.

The field work at the institutions visited by the writer was well carried out and the extent of field trials fully as great as at similar institutions in the United States.

Soils and Fertilizers: The Colleges of Agriculture of Central University, Sun Yatsen University, the University of Nanking and the University of Chekiang have comprehensive courses in soils and fertilizers; while the Colleges of Agriculture at Nantung, the University of Peiping and the Provincial Universities of Hopei, Honan, Anhwei and Kwangsi also give course work in this field. Some of these institutions are well equipped and have rather extensive research under way on various soil and fertilizer problems, comprising field experiments with both organic and inorganic fertilizers, analyses of soils and manures, studies of alkali soils and other problems of local interest.

The Department of Soils and Fertilizers of the National Agricultural Research Bureau with a technical staff of six men have extensive field experiments in seven different provinces, in cooperation with 20 local experiment stations, and are studying fertilizer problems with wheat, rice and cotton. Besides comparing the value of N, P and K alone and in varying proportions, studies are being made of different kinds of organic and inorganic fertilizers, the effects of acidic-inorganic fertilizers when used alone, with lime, with organic manures or both and the residual effect of fertilizers on the succeeding crop.

Very few rotation experiments have been carried on in China, although in many cases the farmers have adopted what appear to be desirable sorts of crop sequences. In recent years the Soils Department of the National Agricultural Research Bureau has initiated several rotation studies in cooperation with local stations.

The Provincial Experiment Station of Chekiang

[6] H. H. Love, T. H. Shen, L. Y. Ma, R. V. Pih, Sheo Wang, S. P. Peng and Y. S. Chen, College of Agr. and For. Univ. of Nanking. Special Report No. 2. 1935.

has started recently comprehensive studies of soil and fertilizer problems with a technical staff of about 15 men. They are making comparative studies of available plant foods in the soils of their province by the following methods: (a) Mitscherlich's pot experimental method, (b) Neubauer's method, (c) the citric-acid method and (d) microbiological methods. They are using field experiments also for the direct study of the value of fertilizers.

The Cotton Improvement Institute of the National Economic Council is making rather extensive studies of manurial experiments in relation to cotton culture. A technical staff of two men is directing these experiments in various regions where cotton is of importance.

A soil survey was started in 1930 in East and Central China by C. F. Shaw, of California. This work was arranged by Dr. Buck, of the University of Nanking, to aid in a survey of land utilization. The work was continued by the Soils Division of the National Geological Survey of China under the direction of Robert L. Pendleton for a two-year period. Special bulletins called "Soil Bulletins" are published by the geological survey. In 1933 James Thorp from the United States was placed in charge of the soil survey. Ten assistants have aided in the studies and a comprehensive summary of the results of the survey is now in press. The work will be continued under the leadership of K. C. Hou.

The Provinces of Chekiang, Kwangsi, Kiangsu and Kwangtung have established their own survey program and a great deal of work has been done in Kwangtung Province.

This rather brief summary emphasizes the extent to which studies of soils and fertilizers have been initiated in recent years. The present indication is that this phase of agricultural research will be expanded further in the near future.

Plant Pathology: According to the report of K. S. Sie in the Yearbook for 1935–36 work in phytopathology was initiated in 1924 and since that time there has been rapid progress. The Phytopathological Society of China was organized in 1929 and now has 36 regular members. Approximately half of the agricultural colleges in China have well-organized departments or laboratories of phytopathology. Rather extensive surveys have been made of the diseases of the more important crop plants, including studies of fruit diseases and of some vegetable diseases. Methods of disease control worked out in foreign countries or in China have been made available to farmers.

Studies of disease resistance have been or are being made, including resistance of millet varieties to smut and downy mildew, resistance of wheat to flag, stinking and loose smuts and resistance of barley to covered smut. Reports of progress show the value of breeding for disease resistance. In recent years studies of resistance to leaf and stripe rusts of wheat have been started at the National Agricultural Research Bureau. Native varieties are susceptible to both diseases, for the most part, but many foreign varieties from both Europe and America are highly resistant.

Copper carbonate dust and other seed disinfectants have been used successfully to control some of the smuts of cereals.

(To be concluded)

OBITUARY

J. ERNEST G. YALDEN

THE sudden death of J. Ernest G. Yalden, of Leonia, N. J., of a heart attack on February 22, 1937, has taken from the number of scientific workers a remarkable individual. A man of wide interests and unusual ability, he developed as an avocation such skill in those matters which attracted him that he became perhaps better known for his work at home than for the distinguished service which he gave in the field of practical education.

Born in England in 1870, Yalden received his early training in the typical boys' school of the period, to be followed by a course in civil engineering at New York University, from which he graduated in 1893. After a few years in the practise of his profession, he was encouraged to submit to the trustees of the Baron de Hirsch Fund a plan for the trade school which they were contemplating. His ideas were so well thought out and so well organized that he was invited to put them into operation.

He thus became the first superintendent and moving spirit of the school, which, until its recent absorption by the New York City system, operated most successfully along the lines indicated in the original plan. The reports of the school written during this period have been carefully studied by those concerned with training for craftsmanship, and many of the ideas have been put to use elsewhere.

Yet the native curiosity of the man and its accompanying thoroughness led him through a host of other experiences which were to profit many besides himself. An enthusiastic yachtsman, he designed and built various boats, from canoes to sea-going yawls, one of which, named by him the *Hippocampus,* has figured in boating literature.

A lover of boats who was fond of mathematics could

hardly escape the lure of navigation and the study of astronomy. It is not surprising then to find Yalden, always a keen student of Euclid, an enthusiastic and leading member of the Association of Variable Star Observers. At his home he built, from his own design, as he did everything else, a compact observatory in which he installed a 4-inch Clark telescope, and with painstaking care adjusted instrument and mounting with a precision rare in small observatories.

His observations on variable stars were characteristically accurate, and before long he had extended his program to include lunar occultations. This led naturally to cooperation with Brown of Yale. Recognition of the excellence of this work was not confined to this country, as his election to the Royal Astronomical Society will testify. However, his observing time was limited, for there were demands for observatory designs. A long list of observatories for colleges, schools and private individuals could be compiled from among the products of his drawing board.

Perhaps Yalden was most widely known as an authority on dialing. He computed many dials, personally constructed models in order to check by experiment, and designed a large number which have been erected in various parts of the country. At the time of his death he had nearly completed the full plans for a large dial of outstanding interest as well as the computations for another. A brochure on dialing came from his pen a short time ago, and his notebooks are full of original and novel dial designs and problems.

Those who knew him best will realize that in these few words only a part of his life has been sketched. It is appropriate in this journal to record a tribute to a late fellow of the American Association for the Advancement of Science, and that those who knew him but slightly may better picture the real Yalden it is right to add at least a suggestion of his skill as a musician, his early friendship with Winslow Homer, his ability in photography, his love of the garden, his charm and patience with the young people who went to him with all kinds of problems, scientific to personal, and not least his loyalty and steadfastness to his many friends.

From a wide experience and his orderly habits of thought Yalden had reached definite conclusions, which might well be considered by all who cherish ambition for achievement in science. Because it was characteristic of the man, he might have written as his message to them: "We know best those things which we do ourselves. Learn by doing."

H. W. FARWELL

WILLIAM ALANSON WHITE

THE following resolutions were passed on March 9 by the council of the Academy of Medicine of Washington, D. C., on the occasion of the death of their president, William Alanson White.

William Alanson White had the true vocation of a physician. His life work covered the period of modern psychiatry. This was no chance relationship, but a real identification, because he was one of the principal creators and interpreters of present concepts in this domain of thought.

To this task he brought the well-balanced talents of a convincing teacher, lucid writer and eloquent speaker. His eminent ability and tremendous energy made him an enthusiastic leader in every enterprise which had for its purpose the increase of knowledge and the more effective use of all measures applied for the relief of the mentally ill, and for the betterment of human relationships. These activities were recognized by institutions of learning which conferred upon him honorary degrees, and by learned societies which bestowed upon him many offices of high honor.

Acquainted as he was through official duties and personal ministry with the weakest and worst of mankind, as well as the strong and good, brought by accident to confusion or disaster, his absorbing preoccupation was the observation and interpretation of human behavior as a manifestation of the personality in all its conflicts and strivings for adjustment and satisfying expression. As a physician he brought to human problems the knowledge of a scientist, the insight of an artist and the gentleness of a brother.

It is then not surprising that he became a philosopher, but it is an index to the nobility of his character that with his knowledge he was still an optimist. There was no man whom he was not willing to help, and no tangled skein of human relationships was so desperate that he could not find some golden thread to follow, by which he could intervene in a helpful manner.

He once compared the field of consciousness to the area of a night-time landscape, illuminated and revealed by a search light, showing clearly a middle ground with shadowy borders. In the world his light has gone out, but the field upon which its rays fell will not again be dark.

Whereas, by the death of Dr. William Alanson White, the Academy of Medicine of Washington, D. C., has lost its first president and the membership a dear and admired friend,

Therefore be it resolved, by the council, on behalf of the academy, that the foregoing sentiments be adopted in appreciation of his worth and as an expression of personal sorrow of the membership, and that the same be recorded in the archives of the academy.

RECENT DEATHS

DR. LEWIS MUHLENBERG HAUPT, consulting civil engineer, from 1875 to 1892 professor of civil engineering at the University of Pennsylvania, died on March 10 in his ninety-third year.

DR. WILLIS G. GREGORY, for forty-six years dean of the School of Pharmacy at the University of Buffalo,

. Y., died on March 20 at the age of seventy-nine ears.

WINFRED W. BRAMAN, until his retirement last ctober associate professor of animal nutrition at the ennsylvania State College, died on March 24 in his xty-third year.

EDWARD P. BURRELL, director of engineering for the Warner and Swasey Company, Cleveland, manufacturers of precision instruments and machinery, died on March 21 at the age of sixty-six years. He directed designing on the large telescopes built by the company during the last twenty years.

COLONEL C. G. THOMSON, superintendent of the Yosemite National Park, died on March 23. He was fifty-four years old.

SCIENTIFIC EVENTS

A PROPOSED SCHOOL OF TECHNOLOGY FOR NEW YORK CITY

MAYOR LA GUARDIA of New York City has announced that the capital outlay budget for the coming ear will provide funds for the opening this autumn f the new city college in the Borough of Queens, to e housed in the buildings formerly occupied by the ueens Parental School near Flushing. The budget ontains an item of $424,000 for the necessary reconruction and equipment of the buildings. The mayor reported to have said:

I would like to have one of our city colleges specialized s a school of technology, perhaps called the New York chool of Technology. They tell me that the College of he City of New York is admirably equipped for this and ould be utilized. Its mechanical equipment is adequate ow, but it is short on laboratory equipment.

Another of the schools should specialize in government. t should be for government in all its branches and for all lasses of employes. It would train in various branches f government such as finance, taxation, government accounting. There would be courses of clerical classes for hose interested in going into this branch of government ervice and making a career of it.

Engineering as it applies to government, such as ferry peration and the like, would be taught. So would mangement and government purchasing methods. I wouldn't bject to the training of young men who would enter the chool with the idea of becoming policemen.

The plan has been submitted by the mayor to a few embers of the Board of Higher Education, the nonalaried agency which controls the city's colleges. These members are to present it to the board for study nd action. Mayor La Guardia continued:

This city has 7,000,000 population and is committed to he policy of free education; that is, I am. States with ot anywhere near as large a population as this city have ree state universities.

In New York City we have a transportation problem in onnection with the colleges which we try to work out by outing the students against traffic, but, even so, attenance is difficult to many.

I think, too, that the city colleges have set an unreasonbly high average mark as their entrance requirement, but this has been more or less necessary because the existing city colleges are overcrowded. The new college in Queens will take care of this. Whether or not the new Queens college is to be a general college will be up to the Board of Higher Education.

The mayor pointed out that City College, Hunter College and Brooklyn College are all overcrowded, a condition which will be eased when the new Queens College is opened. Any changes that may be made will not interfere with students now on the college rolls. None of them would be required to change the institution at which they are now studying.

HONORARY FELLOWSHIPS FOR STUDENT EXECUTIVES AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PRESIDENT KARL T. COMPTON, of the Massachusetts Institute of Technology, has announced the details of a plan for the preparation of young executives for business and industrial positions. This is the continuation of a five-year experimental program which has proved of value not only to the students but to industry as well.

It is proposed to establish a system of honorary fellowships sponsored by thirty-five distinguished business and industrial executives. Beginning in June, fifteen students on leave of absence from their employers will begin a twelve months' intensive program of study consisting of a summer session and a year of graduate education. The selection is now being made from a large group of technically trained men in business and industry. The fellowships will be awarded by invitation only to men of exceptional executive promise, intellectual capacity and physical resource. They will come from the more mature group of younger executives who have had several years of industrial experience following collegiate training in science or engineering.

The establishment of the program is made possible by an anonymous gift of $25,000, providing for scholarship stipends of $1,450 for single men and $1,950 for married students. The course will lead to the degree of master of science in business and engineering administration.

In making the announcement, Dr. Compton said: "The experience of the small group of honorary fellows during our experimental program of the past five years and their remarkable record of success following their fellowship year is convincing evidence of the soundness of this step in administrative education."

The new program will be under the direction of Professor Erwin H. Schell, head of the department of business and engineering administration, who has been in charge of the five-year experimental plan, aided by an advisory committee of educators and executives.

Members of the committee have been appointed as follows: Dr. A. Lawrence Lowell, formerly president of Harvard University; President Frank Aydelotte, of Swarthmore College; The Reverend Leslie Glenn, rector of Christ Church, Cambridge; Edmund C. Mayo, president of the Gorham Manufacturing Company, and President Karl T. Compton, of the Massachusetts Institute of Technology. The faculty will include authorities in the various fields to be covered, business executives collaborating in special studies.

The honorary fellows will live together as a special group, and part of their training will include administrative seminars, weekly conferences with distinguished business and industrial administrators and original research. The unmarried fellows will have quarters in the Graduate House, with a special dining-room and a conference lounge set aside for weekly dinners and business conferences with industrial executives. Special provisions will be made for housing married students.

GEOLOGICAL MAP OF LABERGE AREA, YUKON

A FOUR-MILE-TO-THE-INCH colored geological map of the Laberge Area, Yukon, showing geological boundaries, topography, roads, trails and other features, has been issued by the Geological Survey, Department of Mines and Resources, Ottawa. The map is based on investigations made in recent years by W. E. Cockfield, H. S. Bostock and E. J. Lees and forms a connecting link between the work done in the southern and in the west-central regions of Yukon. It shows the main route of travel down the Lewes River, and should accordingly be particularly useful to prospectors unfamiliar with the region.

Although the Laberge area is traversed by the main water and land routes in Yukon Territory, it has received little attention from the hundreds of prospectors that have traveled the routes on their way to the Klondike area. It is apparent from the investigation made by the department, however, that several sections of the 4,600 square mile area merit attention. In general it has been found that the western half of the area gives promise of yielding non-metallic minerals, particularly coal, in commercial quantities and that the formations in the eastern half are suitable for the occurrence of metals. All known coal deposits are shown on the map, and all are within easy reach of transportation. There has been no production from these deposits, but some of them are similar in nature to those that have been under development for years in the Carmacks area to the northwest.

Placer gold deposits were first discovered in the area in 1881, and deposits have since been found on the bars of Lewes, Teslin and Big Salmon rivers, and on several creeks along the western slope of the Big Salmon range. Lode copper-gold deposits have been found at Loon Lake, and some veins have been staked for lode gold on Livingston Creek, at present the most important source of placer gold output in the area.

THE COAL RESEARCH LABORATORY OF THE CARNEGIE INSTITUTE OF TECHNOLOGY

ACCORDING to the report of a committee appointed by the Board of Trustees of the Carnegie Institute of Technology, of which Dr. Thomas S. Baker is chairman, the sum of approximately $350,000 has been subscribed for the support of the Coal Research Laboratory, thus assuring its continuance for four more years.

Formal announcement was made on March 24, at a meeting in the Engineering Societies Building in New York, attended by representatives of the companies and organizations which are the financial sponsors of the laboratory. A report on the scientific investigations being made at the laboratory was given at the meeting by Dr. H. H. Lowry, director.

The fund committee, which, besides Dr. Baker, consists of Dr. John Johnston, director of research for the United States Steel Corporation, and Howard N. Eavenson, mining engineer of Pittsburgh, began work a year ago to secure additional funds for the continuance of the laboratory. In 1930, when it was founded, sufficient funds for a six-year research program on bituminous coal were given by the Buhl Foundation, the Carnegie Institute of Technology and by six large industrial firms, namely, the U. S. Steel Corporation, the General Electric Company, the Koppers Company, the New York Edison Company, the Standard Oil Company of New Jersey and the Westinghouse Electric and Manufacturing Company.

Through the efforts of the committee, a large number of companies have become sufficiently interested in the work of the laboratory to promise financial aid. Whereas the original grant was secured from a small number of companies, the Buhl Foundation and the Carnegie Institute of Technology, the gifts secured by this committee have been made by a more diversified group of interests, particularly by coal-mine owners and railroads.

The original sponsors for the laboratory which have again given financial support include the Buhl Foundation, the Carnegie Institute of Technology, the U. S. Steel Corporation and the General Electric Company. Contributions now have been made by twenty organizations that did not originally support the laboratory. The members of the fund-raising committee are also members of the technical committee which arranges the scientific program of the laboratory.

SEISMOLOGICAL OBSERVATORY AT WILLIAMS COLLEGE

A SEISMOGRAPH has recently been placed in operation at Williams College. The installation is a gift of Mr. and Mrs. John S. Palmer, 2nd, of Providence, R. I., in memory of their son, Julius Palmer, who, with two of his classmates and Professor Herdman F. Cleland, was lost in the sinking of the steamship *Mohawk* on January 24, 1935.

The station has been placed in the sub-basement of the geological museum at Lat. 42° 42.85′ N., Long. 73° 12.66′ W., elevation 219 meters, and rests on solid Cambrian dolomite a few inches below the floor level. The instruments consist of a Benioff vertical-component seismometer connected with long and short period Miller galvanometers. Time control is obtained from a Seth Thomas regulator clock, registering minute and hour marks on the records and checked daily by U. S. Naval Observatory time signals. The separate rooms for seismometer, recording units, photographic work and radio time control are all constructed of hollow tile and effectively insulate the equipment from the remainder of the building. Very little interference by vibrations from street traffic, trains or disturbances originating in the building is evident on the records.

Dr. N. H. Heck, president of the Seismological Society of America and chief of the Section of Terrestrial Magnetism and Seismology of the U. S. Coast and Geodetic Survey, delivered a brief address at the dedication of the observatory on February 22, outlining the several contributions which may be expected from an installation of this type. Arrangements have been made to cooperate with Science Service and the U. S. Coast and Geodetic Survey in the study of teleseismic activity, while a study of local earthquakes will be made in cooperation with the other Benioff-equipped stations of New England located at Harvard, Weston and Burlington.

ELWYN L. PERRY

SCIENTIFIC NOTES AND NEWS

THE French decoration of Commander of the Legion of Honor was on March 16 conferred on Dr. Robert A. Millikan, of the California Institute of Technology, for his work "in the fields of science and international relations." M. Pascal Bonetti, delegate of the French Ministry of Public Instruction, traveled to the United States especially to bring the award. M. Jean Viala, French consul at Los Angeles, made the presentation.

DR. NIELS BOHR, Hitchcock lecturer at the University of California, was awarded the degree of LL.D. at the Charter Day exercises of the university on March 23. In conferring the degree, President Robert G. Sproul said: "Clear and penetrating thinker concerning the most abstruse problems of the physical world; herald of the concept which is the basis of modern study of the structure of matter; specialist endowed with the highest form of scientific imagination; blessed and blessing with kindliness and true humanity."

IT is announced by the senate of the University of Edinburgh that an honorary degree will be conferred by the university on Dr. L. H. Baekeland, honorary professor of chemical engineering at Columbia University.

A COMMITTEE representing the departments of philosophy of Amherst College, the University of Minnesota and Columbia University honored Dr. Frederick J. E. Woodbridge, Johnsonian professor of philosophy at Columbia University, on the anniversary of his seventieth birthday. The ceremony was held in the Harkness Pavilion of the Columbia-Presbyterian Medical Center, where he is convalescing after an operation. The committee presented to Dr. Woodbridge a volume of his own essays and addresses collected by his former students and associates and published in recognition of the anniversary.

THE New York University College of Engineering will dedicate a new building and power plant in honor of Dr. Collins P. Bliss, dean emeritus, on April 3 at 11:30 A. M. Dr. Bliss retired as administrative head of the college last July after serving for forty years as a member of the faculty. He was succeeded by Dean Thorndike Saville. Dr. W. R. Gregg, chief of the U. S. Weather Bureau; Arthur S. Tuttle, New York state director of the Federal Emergency Administration of Public Works and project engineer of the PWA Queens Midtown Tunnel, who is chairman of the Committee on Engineering of the New York University Council; Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, and Dr. Harvey N. Davis, president of the Stevens Institute of Technology, are among the speakers who will participate in the ceremonies.

PRESENTATION of the Mendel Medal of Villanova College was made by the Very Rev. Edward V. Stanford, president of the college, at a faculty dinner on March 22, to Père Pierre Teilhard de Chardin, S.J., discoverer of the Peking man. M. de Chardin came to the United States to attend the International Symposium on Early Man at the Academy of Natural Sciences of Philadelphia.

DR. ROBERT BROOM, paleontologist of the Transvaal Museum, Pretoria, South Africa, will be the guest of honor at a dinner to be given on April 7 by the Friends of Barnard College. He will speak on "South Africa's Contribution to the Origin of Man." Dean Virginia C. Gildersleeve will preside, and Professor Henry E. Crampton, head of the department of zoology, will be among the speakers.

DR. HAROLD SAFT OLCOTT, research associate at the State University of Iowa, has been chosen by a committee of the American Chemical Society to receive the second Eli Lilly and Company award in biological chemistry, carrying $1,000 and a bronze medal. Dr. Olcott will receive the prize at the opening session of the ninety-third meeting of the society at the University of North Carolina on April 12.

OFFICERS of the Academy of Science of St. Louis elected for the year 1937 are: The Rev. Jas. B. Macelwane, S.J., *president;* Dr. W. H. Roever, *first vice-president;* Professor W. F. Shay, *second vice-president;* Professor W. D. Shipton, *secretary;* Professor C. H. Philpott, *treasurer;* Dr. E. P. Meiners, *librarian;* Professor Paul E. Kretzmann, Dr. Alphonse McMahon, J. H. Porter and Dr. Harold A. Bulger, *councillors-at-large.*

DR. ALBERT JOHANNSEN, professor of geology at the University of Chicago, has retired after more than twenty-seven years in the service of the university. The department of geology is planning to issue in his honor a special volume of *The Journal of Geology,* made up of papers and photographs contributed, for the most part, by his former students.

DR. J. H. JAMES, head of the department of chemical engineering and a member of the original faculty of the Carnegie Institute of Technology, has been granted a year's leave of absence, following which he will retire from teaching.

DR. HERBERT EUGENE WALTER, professor of biology at Brown University and a member of the faculty since 1906, will retire in June to become professor emeritus after forty-one years of active service in the fields of genetics and comparative anatomy. He will be seventy years old on April 19.

PROFESSOR RALPH T. KING, of the department of economic zoology of the University of Minnesota, has been appointed head of the department of zoology and of the Roosevelt Wild Life Forest Experiment Station of the New York State College of Forestry, Syracuse University. He will fill the vacancy caused by the death of Dr. Charles E. Johnson.

DR. ROBERT M. MOORE, assistant professor of pathology of the School of Medicine of the University of Missouri, has been appointed professor of pathology and director of clinical laboratory diagnosis in the School of Medicine of the University of Mississippi.

KNOWLES A. RYERSON, until recently chief of the Bureau of Plant Industry of the U. S. Department of Agriculture, has been appointed to succeed Dr. W. L. Howard as director of the branch of the College of Agriculture of the University of California at Davis. Dr. Howard, who has served as director since 1924, will continue as professor of pomology.

DR. WALTER T. HARRISON, senior surgeon in the National Institute of Health, has been placed in charge of the Division of Biological Control of the U. S. Public Health Service.

EDMUND SECREST, state forester, has been appointed director of the Ohio Agricultural Experiment Station at Wooster. He succeeds Dr. C. G. Williams, who will retire on July 1, after having been on the staff continuously for thirty-four years.

THE Committee on Scientific Research of the American Medical Association has made a grant to Dr. Samuel Soskin, director of metabolic and endocrine research at the Michael Reese Hospital, Chicago, to aid his work on the hormone assay of blood and urine in endocrine dysfunction.

DR. H. K. HAYES, chief of the Division of Agronomy and Plant Genetics, University of Minnesota, has returned after spending the past year directing research activities and graduate study at the University of Nanking.

PROFESSOR GEORGE MIKSCH SUTTON, artist, curator of birds at Cornell University, will spend the coming spring in the southwestern United States, centering his attention upon a state-wide survey of the bird-life of Oklahoma. He will leave Ithaca about April 10.

DR. J. NEYMAN, reader in statistics at University College, London, arrived in New York on April 1 for a stay of six weeks. He will deliver lectures and hold conferences at Princeton, the Graduate School of the U. S. Department of Agriculture, Columbia, Brown, Chicago, Michigan, Illinois, Iowa and Iowa State College. Dr. Neyman founded the Statistical Laboratory of the Central Agricultural Institute at Warsaw, and has done pioneer work in the interpretation of experiments in bacteriology, crop yield and social censuses.

DR. LEO LOEB, professor emeritus of pathology of the Washington University School of Medicine, St. Louis, gave on March 30 the fourth Arno B. Luckhardt lecture, under the auspices of the Delta chapter of Phi Beta Pi. His subject was "The Biological Basis of Individuality."

DR. W. F. G. SWANN, director of the Bartol Foundation of the Franklin Institute, will deliver at New York University on April 9 at 8:30 P. M. a James Arthur lecture, entitled "What is Time?" Dr. R. W. Gerard, of the University of Chicago, will give on April 15 a James Arthur lecture at the American Museum of Natural History at 8:15 P. M. He will speak on "Dynamic Neural Patterns."

DR. EARLE RAYMOND HEDRICK, professor of mathematics, vice-president and provost of the University of California at Los Angeles, gave the Charter-day address on the occasion of the sixty-ninth anniversary of the founding of the University of California on March 19.

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, delivered on Easter Sunday under the auspices of the National Broadcasting Company a radio address entitled "We Must Shape Our New World."

DR. THEOPHILUS S. PAINTER, professor of zoology at the University of Texas, delivered an address on "Recent Developments in our Knowledge of Chromosome Structure" before the Brown University Chapter of Sigma Xi on March 19.

THE REV. V. C. STECHSCHULTE, S.J., director of the Xavier Seismological Observatory, on March 18 addressed the University of Cincinnati chapter of Sigma Xi on "Earthquakes and Seismographs."

THE Federation of American Societies of Experimental Biology, which includes the American Physiological Society, the American Society of Biological Chemists, the American Society for Pharmacology and Experimental Therapeutics and the American Society for Experimental Pathology, will hold its annual meeting under the presidency of Dr. Arno B. Luckhardt, of the University of Chicago, at Memphis, Tenn., from April 20 to 24.

THE two hundred and thirteenth regular meeting of the American Physical Society will be held in Washington, D. C., on Thursday, Friday and Saturday, April 29, 30 and May 1. The Thursday and Friday sessions will be held at the National Bureau of Standards and the Saturday sessions at the George Washington University. Other meetings for the current season are as follows: June 21 to 25, Denver, Colo., the Pacific Coast Section in affiliation with the American Association for the Advancement of Science; June 22 and 23, Madison, Wis.; November 26 and 27, Chicago, Ill.; Pacific Coast meeting, December, 1937; annual meeting, in affiliation with the American Association for the Advancement of Science, December 27, 1937, to January 1, 1938, Indianapolis, Ind.

THE eighth spring meeting of the Eastern Branch of the American Psychological Association will be held on Saturday, April 3, at Vassar College, Poughkeepsie, N. Y. Morning sessions will be devoted to conditioned responses, sensory processes, abnormal psychology and attitudes. At a luncheon the honorary president, Dr. Samuel W. Fernberger, of the University of Pennsylvania, will deliver an address on "A Psychological Cycle." The afternoon sessions will be divided into five groups—learning and memory, brain processes, comparative psychology, psychometrics and applied psychology. A tea will conclude the meeting.

THE annual meetings of the Pacific Coast Branches of the Paleontological Society, the Seismological Society of America and the Cordilleran Section of the Geological Society of America will be held at the University of California on April 9 and 10.

A MATHEMATICAL symposium on "The Calculus of Variations" will be held at the University of Notre Dame on Wednesday and Thursday, April 7 and 8. Leading authorities in the field have accepted invitations to present papers and to engage in the discussion. The last session will be devoted to applications of the calculus of variations in the fields of economics and physics. The program includes a general lecture on "What is Topology?" by Dr. Solomon Lefschetz, of Princeton University, president of the American Mathematical Society.

THE California Institute of Technology has received an anonymous gift of $750,000 to be used in the Division of the Humanities.

THE will of Dr. Edward S. Robinson, professor of psychology at Yale University, leaves his estate in trust to his mother, Mrs. Carrie S. Robinson, of Wheeling, W. Va., for life, and after her death the trust passes to Yale University.

DR. WILLIAM JOHNSON SOLLAS, professor of geology and paleontology at the University of Oxford, who died last October at the age of eighty-seven years, left his estate of the gross value of £15,937, subject to life interests, "to found a fellowship at University College, Oxford, for the advancement of knowledge in some branch of geology."

THERE has been established at Colgate University the McGregory fellowship in chemistry, to be awarded to a member of the graduating class each year for graduate study in chemistry in the United States or abroad, the McGregory Lectureship, a fund to be used

to bring guest lecturers on chemical subjects to the university each year, and a fund for the purchase of books on chemistry for the departmental library. These funds represent the annual income from the estate of the late Joseph Frank McGregory, professor and head of the department of chemistry for forty-five years, and are being used in accordance with the terms of his will.

A DAVID ANDERSON-BERRY GOLD MEDAL, together with a sum of money amounting to about £100, will be awarded in July, 1938, by the Royal Society of Edinburgh to the person, who, in the opinion of the council, has recently produced the best work on the nature of x-rays in their therapeutical effect on human diseases. A similar award will be made every three years. Applications may be based on both published and unpublished work and should be accompanied by copies of relevant papers. They must be in the hands of the General Secretary of the Royal Society of Edinburgh by June 1, 1938.

THE United States Senate passed on March 23 the amendment to the 1934 Communications Act, making it possible for the Cruft Laboratory at Harvard University to resume experiments in automatic radio devices that offer high promise for use in police protective work and in other fields. The 1934 law made it necessary for the Cruft station to shut down for lack of a licensed operator. The Cruft Laboratory had been employing an automatic device capable of preventing improper operation of the station, and informed the Federal Communications Commission that it could not afford to keep an operator on duty throughout continuous operation. The amendment authorizes the commission to make special regulations governing the use of automatic radio devices.

IT is reported in *Nature* that at the annual general meeting on March 10 of the British Institute of Metals the president of the institute announced that, as a first step in a plan of cooperation with the Iron and Steel Institute, members of each institute can become members, associates and student members of the British institute on application. Combined annual subscriptions and entrance fees have also been arranged. The present scheme of cooperation follows one recently completed by the two institutes with the American Institute of Mining and Metallurgical Engineers, whereby members, associates and student members of the British Institutes may, if under the age of thirty-three years, become junior foreign affiliates of the American Institute of Mining and Metallurgical Engineers on specially favorable terms, the arrangement being reciprocal in the case of members of the American society. The president also announced that the council has decided to issue an appeal for the creation of an endowment fund, to be invested for the support and extension of the work of the institute.

DISCUSSION

HURRICANE PALMS IN FLORIDA, INCLUDING A NEW GENUS SIMPSONIA

THE native flora of southern Florida is truly tropical, with ten indigenous genera of palms, nearly as many as the entire continent of Africa. Five of the native genera, Roystonea, Inodes, Paurotis, Serenoa and Simpsonia, are specially adapted to exposed situations, together with the coconut and other resistant types that have been introduced. Some of the native Florida palms are scarcely known in collections, but have special value for open plantings where wind resistance is desired, with beauty and variety. Even against the trade-winds, gardens or orchards often need protection, and districts with many resistant palms undoubtedly would suffer less from hurricanes or from the fires and frosts that visit denuded districts in the dry winter season. Making Florida a winter paradise may appear more important than planting for production, though for either purpose groves or shelter-belts of palms would be of value.

Palms are specialized for particular environments more than has been appreciated, in three rather definite ecological series: First, the sun palms, requiring full exposure; second, the palms that live as forest trees; and third, the undergrowth palms, adapted to permanent shade conditions. The primitive palms doubtless were plants of open country, like those now confined to seacoasts, sand dunes or rocky deserts. The tree palms develop in partial shade through their seedling and juvenile stages, but eventually over-top the forest and reach the sunlight. Palms from forests usually thrive in conservatories, while sun palms languish or die. Adaptive characters often are omitted from taxonomic descriptions but need to be known before new plants can be grown and appreciated.

The resistance of the coconut palm is featured in many accounts of hurricanes in low-lying coral islands in the Pacific Ocean. All the other trees may uproot and wash away, but coconut palms hold fast and the natives take refuge aloft. Many coconut palms withstood the hurricane that visited Palm Beach, Fla., on September 16, 1928, while most of the branching "hardwood" trees were completely wrecked. The native royal palms, *Roystonea floridana*, also showed

notable resistance, their massive trunks often remaining in place where neighboring coconut palms were broken off or uprooted. The specialized features of royal palms are the smooth rigid trunks, the compact bundle of leaf sheaths protecting the terminal bud, and the stiff, brittle petioles where the leaves break off and thus "shorten sail" in severe winds. New crowns of leaves are put forth in a few months, before the coconut palms can replace their rusty, storm-frayed foliage.

Another resistant type was signalized at Palm Beach, the Mascarene cabbage palm, *Linoma alba*, earlier known as Areca or Dictyosperma, that stood entirely unhurt among the wreckage of the gardens, and began to be known as "the hurricane palm." It is smaller than the coconut palm, with leaves of similar form, but so firm and fibrous as not to be whipped or shredded by the wind. Linoma is a native of Mauritius, one of the Mascarene islands in the hurricane belt of the Indian Ocean, famous a century ago as the setting of "Paul and Virginia," an idyl of tropical felicity published at the beginning of the French Revolution by Bernardin de Saint Pierre, the friend and successor of Rousseau in preaching the return to nature.

Linoma doubtless will be planted in larger numbers, since seeding palms are becoming frequent. As the *chou palmiste* of Mauritius it has repute as a delicious salad, and tinned "palm hearts" have been an article of export from the neighboring island of Reunion. The different kinds of palm hearts might be compared and their dietary uses developed if large groves or shelter-belts were established. Planting the Florida palmetto for its cabbage has been suggested, but royal palms grow much faster and their edible buds are larger.

The native cabbage palmetto (*Inodes palmetto*) and the even more abundant saw palmetto (*Serenoa serrulata*) belong to the series of hurricane palms, and are resistant also to drought, fire and frost, so that vast areas are occupied, that give Florida preeminence as a palm country. The low reclining trunks of the saw palmetto rise in groups from branching underground root-stocks and furnish an ideal cover for embankments, sand dunes or sea coasts, though very difficult to remove in clearing land.

Paurotis is a larger social palm, with slender trunks 20 to 30 feet high forming dense hurricane barriers or growing in graceful clusters, not exceeded in beauty by any other palm. The foliage is not bluish or grayish as in Serenoa, but a shining emerald green, with the long, light-yellow inflorescences rising like jets from a fountain. Paurotis is very intolerant of shade, and in the wild state is restricted to small hammocks in open fire-swept stretches of the Everglades, rarely visited by tourists. The awkward name Acoelorraphe often is applied to Paurotis, but its original use by Wendland in 1879 referred to the saw palmetto.

The new genus of hurricane palms is an example of specialization for an extreme habitat on naked limestone formations of the lower Florida Keys. It is not a social palm, but compact and robust, attaining 25 to 30 feet, notably larger than Thrinax or Coccothrinax, and thriving entirely in the open, beyond the range of other woody vegetation. The outstanding adaptive feature is the development of large cushions of fine interlacing superficial roots at the base of the trunk, like the spongy aerial root-growth of some of the orchids and other epiphytic plants. The leaves are close-veined and firm-textured like those of Linoma, with a chalky white coating of the lower surface, doubtless reducing transpiration. Small white berries are produced in great abundance, and very small seeds, finding lodgment in narrow crevices.

For this most specialized native palm the name *Simpsonia* is proposed as a tribute of regard and admiration for the late Charles Torrey Simpson, whom future times may recognize as a great pioneer naturalist of tropical Florida. The genus is next to Thrinax, but with several diagnostic characters, the massive columnar trunk, often more than a foot in diameter, acervate radicels, cretaceous induments, subsessile flowers, imperforate endosperm and lateral embryo. The type species, *Simpsonia microcarpa* (Sargent) is described and illustrated in Sargent's "Silva of North America" (2: 53) as *Thrinax microcarpa*, from No Name Key, and later in the same work (14: 83) as *Thrinax keyensis*, a larger form from the Marquesas Keys, west of Key West. A thrifty specimen of the type species was raised by Simpson in his garden near Little River.

O. F. COOK

BUREAU OF PLANT INDUSTRY
U. S. DEPARTMENT OF AGRICULTURE

CARBONATION AND CARBONATIZATION

W. A. TARR recently argued against the use in geology of the term "carbonatization," and supported his view-point with a list of several text-books that employ the simpler term "carbonation."[1] The present writer takes no issue with the general argument, as suggested by his adoption of the shorter term in a book that antedates at least two of those in Tarr's list.[2] Every question merits examination on both sides, however, and it is of interest to inquire why some geologists have preferred the longer and less attractive word.

"Carbonation" is the logical derivative of the verb "carbonate," which may appear to relate directly to the formation of carbonates. Unfortunately, several

[1] SCIENCE, 85: 198, 1937.

[2] C. R. Longwell, A. Knopf and R. F. Flint, "Textbook of Geology," Part I, p. 17, 1932.

dictionaries give as their first definition of this verb, "to carbonize; to reduce to carbon." One dictionary (The Universal) gives no other definition, and another (The Century, 1911 ed.) omits any mention of this meaning, giving as the sole definition, "to impregnate or saturate with carbonic acid" (as in the formation of carbonated waters). The New Standard Dictionary gives both meanings listed above, but does not mention the formation of carbonates. Webster's New International, which probably is used as widely as any dictionary in this country, defines "carbonate" (the verb) as follows (1934 ed.): "1. To burn to carbon; carbonize. 2. *Chem.* a, To convert into a carbonate. b, To impregnate with carbonic acid or carbon dioxide." This same dictionary, and others, define "carbonation" as "act or process of carbonating," thus involving the noun in the diverse usage of the verb. Dictionary makers, then, do not by any means give the unequivocal guidance suggested in Tarr's note. Since "carbonize" is given as a synonym of "carbonate," there appears to be dictionary license for using "carbonation" in reference to the accumulation of organic matter in soils or in marine muds; the concentration of fixed carbon in maturing coals; the charging of subsurface waters with carbon dioxide; and the development of carbonates, either by weathering or by hydrothermal action. Although this full range of license is not met in common usage, geologists show no disposition to restrict "carbonation" to one specific meaning.

Probably "carbonatization" originated from a desire to have a term that means unmistakably the development of carbonates. Certainly this desire explains the use of the word by some writers within recent years. Another and apparently older form, "carbonatation,"[3] may have had its origin in the same consideration. Users of these longer words in lieu of "carbonation" probably have felt that clearness is more important than euphony in scientific writing. They need not be disturbed by lack of conformity with the words "hydration" and "oxidation." The English language is not noted for exact consistency in word-form; moreover, any one disposed to quibble in this matter might claim that if "carbonation" and "hydration" refer to production of carbonates and hydrates, then "oxidation" should signify the formation of *oxidates!* It is a more effective argument that "hydration" and "oxidation," as now defined and used, are not in any way ambiguous, whereas "carbonation" may be misunderstood.

Thus the advocates of "carbonatization" are not without justification. They could even compile an imposing list of articles and books to make a case on the ground of usage. However, the writer has used "carbonation" in reference to the formation of carbonates, for the following reasons: (1) The verb "carbonize" and its derivative "carbonization" are adequate in expressing reduction to and impregnation with carbon; if geologists are careful to observe this logical usage, considerable confusion will be avoided. (2) Although the verb "carbonate" and its noun "carbonation" must still do double duty, ordinarily it should be clear from the context whether the formation of carbonates or merely charging with carbon dioxide is intended. However, the more cumbersome "carbonatization" at least has the advantage of precision, and the present writer will not be unhappy if he continues to meet the term in geologic literature.

[3] *Cf.* Century Dictionary, 1889 and later editions.

C. R. LONGWELL
YALE UNIVERSITY

THOSE annotating changes in scientific vocabulary are probably aware of the roots of the English language. Yet workers rarely employ the devices of philology. We, naturally, say "rarefaction," but would not suggest "rarization." Yet the form mentioned recently in SCIENCE, "carbonization," means to render foreign, as of shoes, using rough, uncivilized leather. The chemists can not have thought twice. (Greek, *Karbanos,* page 137, Hamilton, London, Crosby, Lockwood and Co., 1887; *-ize* is Greek.)

The Latin word *carbo(n)* means "coals." Its etymology is thought dubious (White, Ginn and Co., Boston, 1893, page 95). The form *ifaction* is good Latin: "Carbonifaction" or "carbonify."

We do say "temporize." And do not say "temporization." It is possible to say "temporizing." Instead of the term "carbonatization" for "carbonating," why not use it? And for products or processes "carbonators" and "carbonative," "carbonifactors" and "carbonificients," as well as "carbonifacts"? And "carbonatifacts," with "carbonatifactors" and "carbonatories"?

THOMAS HORACE EVANS

THE FIRST RECORD OF THE BLACK WIDOW SPIDER FOR IOWA

IN "Notes on the Distribution of the Black Widow Spider," by L. D. Anderson and H. G. Walker, in SCIENCE for January 22, 1937, Minnesota and Iowa are listed as the only states from which this spider has not been officially recorded. The writer believes that Iowa may be added to the "black list."

In the fall of 1936 a specimen was collected in the warehouse of a Cedar Rapids machinery company. While the author identified the specimen as a female black widow spider, the unusual color markings, combined with the fact that this species of spider had not been reported from Iowa, made him cautious about reporting it without verification. It was first sent to Donald G. Lowrie, of the University of Chicago, who

verified the author's identification. He suggested that because of its unusual color markings it might be a geographical subspecies. The markings were not typical for any of the three varieties described for the United States by Chamberlain and Ivie,[1] so it was then sent to Professor Chamberlain, who identified it as an extreme variation of *Latrodectus mactans texanus*. Since this spider was collected in a warehouse, it was thought that it might represent an import; but Professor Chamberlain stated that while this is a possibility it need not be true; that while Iowa would be the northern range for it, the form no doubt occurs here, as it is not uncommon in Kansas.

Field studies will be made next summer in an effort to determine the abundance and varieties of the black widow spider in this locality, and it will be especially interesting to observe whether the extreme variation of this first record will be found again in future investigations.

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SOCIETIES AND MEETINGS

THE PENNSYLVANIA ACADEMY OF SCIENCE

The regular annual meeting of the Pennsylvania Academy of Science was held at Lancaster, Pa., in conjunction with the Pennsylvania Conference of College Physics Teachers and the Pennsylvania Junior Academy of Science, on Friday and Saturday, March 26 and 27. The meetings were all conducted on the campus of Franklin and Marshall College, President Thomas D. Cope, of the academy, ably presiding. The college and the Lancaster Branch of the American Association for the Advancement of Science were hosts. A total registration of 355 was recorded, including over 150 for the Junior Academy.

Friday was mainly devoted to the reading of papers before the academy. Thirty-six titles were presented, the distribution by subjects being as follows: Zoology 16, geology 10, botany 3, physics 2, education 2, miscellaneous 3. The Pennsylvania Conference of College Physics Teachers and the Junior Academy held independent sessions during Friday afternoon. At the former, thirteen, and at the latter, twenty-one titles were presented. The reading of the papers was supplemented by a number of exhibits and demonstrations, chiefly biological. There was a joint session of the academy and conference and guests on Saturday morning, at which seven invited papers were read. The sessions ended shortly after noon on Saturday.

Following the annual dinner on Friday evening at the Hotel Brunswick, the several organizations and guests assembled in Hensel Hall at the college to listen to the guest speaker for the annual academy lecture, Dr. F. R. Moulton, recently elected permanent secretary of the American Association for the Advancement of Science. Dr. Moulton chose for his subject "Science." He pointed out the present rapid growth of the value of applied science to human affairs and then indicated what a vast potentiality remains in this field for the future.

During the regular business meeting the following officers for 1937–38 were elected:

President: Dr. Geo. H. Ashley, state geologist of Pennsylvania.
Vice-President: Jaques Cattell, The Science Press.
Secretary: Dr. V. Earl Light, Lebanon Valley College.
Treasurer: Dr. C. W. Thurston, Pennsylvania State College.
Assistant Secretary: Charles E. Mohr, Reading Senior High School.
Editor: Ralph W. Stone, the Pennsylvania Topographic and Geologic Survey.
Press Secretary: Dr. Bradford Willard, the Pennsylvania Topographic and Geologic Survey.

The summer meeting for 1937 will be held at a date to be announced. It is planned to assemble at Wellsboro and visit Harrison State Park and the Coudersport ice mine. The regular annual meeting for 1938 is scheduled to be held at Bucknell College, Lewisburg, the date to be announced later.

The sessions just closed are considered to be among the most successful and best attended in the history of the academy. Much of this success is due to the efforts of the members of the Lancaster Branch of the American Association for the Advancement of Science and Franklin and Marshall College, particularly to Jaques Cattell, chairman of the Lancaster Branch and of the local committee on arrangements, and to Professors R. L. Charles and Howard M. Fry, of Franklin and Marshall College.

Bradford Willard,
Press Secretary

THE KANSAS ACADEMY OF SCIENCE[1]

The Kansas Academy of Science was organized on September 1, 1868. For three years it was called the "State Natural History Society," but on October 25, 1871, the name was changed to the "Kansas Academy of Science." The society has held 68 annual meetings and has published 39 volumes of *Transactions*. These volumes comprise about 9,000 pages of printed matter, of which about 8,600 pages are devoted to scientific

[1] *Bull. of the University of Utah*, Vol. 25, No. 8, 1935.

[1] Report to the Annual Conference of the Academies, December 28, 1936.

reports and the other pages to reports of officers and business matters. Many of the papers report details of local plants, animals, insects and minerals, but a very large number are concerned with matters of general scientific interest, both theoretical and practical. The cost of publication, except for the years 1921–33, has been borne by state appropriation.

The academy had accumulated about 20,000 volumes of scientific magazines and books, largely by exchanges. Six years ago the academy allocated this library to three of the state schools. These institutions are cataloging and integrating the exchange journals into their libraries. By a system of mutual loaning, all books and periodicals are available to every one of the academy members from any one of the cooperating institutional libraries.

The annual meetings are held in odd years alternately at the State University at Lawrence and the State College at Manhattan and on even years at the various smaller colleges. The meetings are usually held a week after Easter and last from Thursday evening through Saturday afternoon. The evening meetings are given over to special lectures and the afternoons and parts of the forenoons to sectional meetings. The following sciences hold sectional meetings: Chemistry, physics, botany, zoology, entomology, psychology, medical sciences—bacteriology, physiology and anatomy and the Junior Academy.

In 1935, 150 papers were presented in the different sections and in 1936 meetings in a smaller college there were 120 papers. At the end of the 1936 session there were 430 members.

The Junior Academy has a number of very active clubs and holds an enthusiastic meeting on Friday afternoon. The organization of new clubs is being actively pushed by the academy. A special committee is handling this phase of the work.

A special committee has been appointed to study out the best plan of encouraging research work by the use of the research award of the American Association for the Advancement of Science. They are also finding ways and means to add to the amount of the award.

The committee on conservation of plants and animals is setting aside natural preserves in various parts of the state. It already has some "state parks" to its credit.

Another committee is working out a plan by which all the scientists of the state shall have some means of cooperating for the welfare of the state. It is hoped to create some kind of a super-council, a Kansas Association for the Advancement of Science, to include: The Kansas Engineering Society, the Kansas Horticultural Society, the Kansas Medical Association, the Kansas Dental Association, the Kansas Home Economics Association, the Kansas Mathematical Society (partly concerned with teaching), the Kansas Geological Society (partly commercial) and any others who are carrying on research or investigations. The Kansas delegate to the American Association for the Advancement of Science meeting is anxious to receive any and all suggestions for getting more cooperation among state scientists. It is believed that if the scientists of a state act as an aggregate they could add much to the efficiency of state governments and that they could often be of great benefit to each other and their respective societies.

W. J. BAUMGARTNER,
Delegate from Kansas Academy of Science

SPECIAL ARTICLES

TOXOPLASMA AND OBLIGATE INTRACELLULAR PARASITISM

TOXOPLASMA have been described as the causative agents of various pathologic conditions in birds and mammals, including man, in various parts of the world, but hitherto almost unnoticed in North America. The accidental isolation of toxoplasma early in 1935[1] in the course of experimental work with viruses has led to a study of these parasites by methods and procedures commonly used in virus work. The purpose of this communication is to call attention to some of the more striking results which were thus obtained, particularly their apparent obligate intracellular parasitism, and to indicate that as a result of this property these highly organized parasites (about $6–7 \times 3–4\ \mu$) have many features in common with certain ultramicroscopic viruses. Many of the problems encountered in the study of virus diseases, such as cultivation, pathogenesis, immunity, etc., are, to a great extent, influenced by the obligate intracellular "parasitism" which is an outstanding characteristic of the filtrable viruses.

In the course of tests for virus in guinea pig brains, two mice, injected intracerebrally, exhibited signs of encephalomyelitis nine days later, which proved not to be due to the virus under investigation. The disease was readily transmissible in series by intracerebral injection[2] of mice and was shown by extensive subsequent studies to be caused by a parasite which, in

[1] Toxoplasma were observed in guinea pigs in Mexico (H. Mooser, *J. Inf. Dis.*, 44: 186, 1929) and in birds of the Syracuse, N. Y., region, also in English sparrows kept in the laboratory and in canaries (R. D. Manwell and C. Herman, *J. Parasitol.*, 21: 415, 1935).

[2] All such operations were done with the aid of ether anesthesia.

morphology and in the wide range of hosts for which it proved pathogenic, corresponded closely to the as yet ill-defined group of Protozoa called *Toxoplasma*. Numerous investigations extending over the past two years have been made possible by proper preservation of the parasite, which, after many trials, consisted of storing an infected mouse brain in Tyrode's solution in the refrigerator for 14 days and then passaging it by intracerebral injection of mice. Fifty brain-to-brain passages have now been accomplished with the strain obtained from one of the original mice, and thirty-six with that from the other.

Our studies on the biology of these strains revealed that multiplication was possible only within living cells. The process consisted of penetration of the susceptible cell by the semilunar or piriform-shaped parasite and subsequent division by longitudinal fission. In the first two mouse passages after isolation both strains multiplied until they filled and distended the cells, leading usually to the ultimate extrusion of the nucleus and leaving structures consisting sometimes of hundreds of the parasites surrounded by the cell membrane and referred to by some as "cysts" or "pseudocysts." With the third intracerebral passage a spontaneous change occurred in one of the strains, whereby the invaded cells disintegrated when the total number of parasites in them was still quite small. This change was accompanied by a marked increase in pathogenicity that did not occur with the second strain until after about the twenty-fifth passage. In keeping with this observed intracellular parasitism, it was not surprising that they failed to multiply in media which did not contain living, susceptible tissue. Defibrinated blood did not support their growth. They could be cultivated, however, when minced chick embryo suspended in Tyrode's solution (the Li-Rivers medium, in which many viruses have been cultivated) was used. In this medium two series of six successful subcultures were carried out without loss of pathogenicity. The multiplication was found to occur within the cells. Concentrated, cell-free, Tyrode's solution extracts of chick embryo, inoculated for control, contained no living parasites even in the first culture, 4 days after incubation at 37° C.

The pathogenicity of our strains was studied in a number of different hosts. They produced fatal infections in mice, guinea pigs, rabbits and newly hatched and full-grown chickens; in *rhesus* monkeys a non-fatal disease was induced. Mice succumbed to infection when the parasites were given directly into the brain, into the peritoneal cavity, under the skin and even after instillation without trauma by way of the nose or mouth. With the increased pathogenicity acquired by passage, intracerebral injection in mice caused death within three to five days. The brain was always involved in mice, regardless of the route of inoculation, but pathological studies revealed that the distribution of the lesions was characteristically different after intracerebral and after peripheral inoculation. In the former instance the parasites were distributed by way of the cerebrospinal fluid and the lesions were situated chiefly periventricularly, at the base of the brain, and dorsally about the midbrain, while after peripheral inoculation the lesions were in the cerebral blood vessels and in the nerve cells surrounding them. The growth of the toxoplasma through the vessels, parasitizing cells of almost all the coats, and the subsequent perivascular nerve cell involvement were clearly apparent. Next to the brain the lungs were most constantly affected, while vascular organs, such as the kidney and liver, rarely showed any appreciable lesions, even though the parasites could be shown by animal inoculation to be present in the blood and all the organs.

It is not known how toxoplasmic infection is transmitted in nature. While an insect vector has been suspected, none has been identified or demonstrated. Our own experiments on contact infection among mice were entirely negative, until small numbers of starved animals were allowed to feed on others recently dead of the experimental disease. This suggests that at least one method of natural dissemination may be by means of the eating of toxoplasma-contaminated tissues.

Intracerebral inoculation in guinea pigs and rabbits led to fatal infection within four to six days, but the attack was chiefly on the meninges (dorsal as well as ventral). The distribution of nerve-cell lesions was directly beneath the meninges and almost not at all along the ventricles. Intracutaneous injection of the unchanged strain (*i.e.*, before the capacity of early disintegration of the parasitized cell was acquired) induced local skin lesions associated with systemic disease, but the rabbits always survived. After the spontaneous change occurred, more marked hemorrhagic and necrotic skin lesions ensued associated with systemic disease which invariably led to death of the animal within 8 to 12 days. A study of the pathogenesis of the latter disease revealed that the parasites were distributed to all the organs by way of the blood, but here again variations in the relative vulnerability of the viscera were apparent. As contrasted with the mouse, the rabbit brain showed little or no change, while the liver, spleen, adrenals, intestines and lungs were the seat of multiple focal lesions which in the gross, and even under the low power of the microscope, were almost indistinguishable in appearance and localization from the lesions of generalized vaccinia and certain other viruses. Under greater magnification one could see that the focal necrotic lesions were

due (1) to a growth through the vessels, *i.e.*, intracytoplasmic multiplication of the parasites and ultimate distintegration of the cells constituting their walls, with secondary involvement of the parenchymal cells by the parasites, and (2) to thrombosis of involved blood vessels with secondary necrosis of parenchymal cells without preliminary parasitization. The kidneys were again, strangely enough, only irregularly affected, and even then only the interstitial vessels seemed to suffer while the glomeruli and tubules appeared almost uninvolved. The destruction of cells either directly by the parasites or indirectly by thrombosis of blood vessels whose walls were parasitized comprised the outstanding pathological changes, while inflammation was either absent or, in certain instances, a late manifestation.

Intracerebral inoculation in *rhesus* monkeys was followed only by a febrile disease. Intracutaneous injection gave rise to a local lesion associated, as after other forms of peripheral inoculation, with systemic disease and the presence of the parasites in the circulating blood, as demonstrated by mouse inoculation.

The toxoplasma also appear to offer an opportunity for direct investigation of certain as yet obscure problems in immunity of obligate intracellular parasites. It has been possible to show, for example, that *rhesus* monkeys recovering from an infection with toxoplasma are immune to reinoculation and that the serum of such monkeys contains antibodies which may be termed "neutralizing" or "protective." The "neutralization" or "protection" tests were performed in the same manner as with viruses, *i.e.*, by mixing *in vitro* the serum with a tissue suspension or exudate containing the parasites and injecting the mixture intracerebrally or intraperitoneally in mice or intracutaneously in rabbits. The latter proved to be the method of choice, since the parasite suspension as well as a number of different sera could all be titrated quantitatively on the back of one rabbit. It was interesting, however, that rabbits which recovered from the non-fatal disease induced by the intracutaneous injection of the "unchanged" toxoplasma developed a solid tissue immunity resisting the constantly fatal intracerebral injection of the same strain, as well as inoculations with the highly pathogenic and fatal changed strain, but, as a rule, had no demonstrable protective humoral antibodies. In some rabbits only sufficient antibody to protect against a single skin infective dose was present. Similar observations are not uncommon with certain viruses.

Preliminary studies on the protective antibody in convalescent monkey sera revealed that it apparently had no effect on the toxoplasma *in vitro*. No agglutination or disintegration of the parasites could be observed in mixtures which proved innocuous on animal inoculation. Centrifugation of such mixtures after incubation for several hours *in vitro* and separation of the parasites from the serum showed that they had retained their infectivity. Further studies now in progress on the nature of this protective antibody, as well as the solid tissue immunity unassociated with such antibodies, are expected to yield data of interest to the understanding of similar phenomena with other obligate intracellular parasites.

The rabbit skin protection test may, perhaps, also prove useful in the diagnosis of infection with toxoplasma. The present evidence that they cause disease in man is rather tenuous and has been questioned by many competent parasitologists. The reason for this uncertainty is that the diagnosis has been based either entirely on morphological grounds without tests for pathogenicity or only on animal inoculation. In a recent study[3] on glandular fever (infectious mononucleosis) doubt arose as to whether the toxoplasma which were isolated were derived from the patients' blood or from the experimental animals (rabbits) which might have been spontaneously infected. The protection test just described might aid in elucidating this problem.

The work just outlined will be described in detail in a future communication. The aim of the present report is primarily to call attention to the existence of toxoplasma in North America and to point out their obligate intracellular parasitism, a study of which reveals many features in common with certain of the filtrable viruses, particularly as regards pathogenesis, cultivation, immunity and other host-parasite relationships.

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HEPARIN AND THE FORMATION OF WHITE THROMBI

In a recent preliminary communication Murray, Jaques, Perrett and Best[1] reported that the incidence of thrombus formation after mechanical or chemical injury to veins was appreciably decreased when a solution of purified heparin was administered to the dogs before and for adequate periods after the injury. In animals which did not receive heparin the injury was followed by the appearance of typical thrombi. Areas exhibiting the structure of thrombi could be observed in many of the histological sections made through the obstructing mass. Since the veins from the heparinized animals were in many cases free of obstruction,

[3] J. O. W. Bland, *Lancet*, 2: 521, 1930; *Brit. Jour. Exp. Path.*, 12: 311, 1931.

[1] D. W. G. Murray, L. B. Jaques, T. S. Perrett and C. H. Best, *Can. Med. Assoc. Jour.*, 35: 621, 1936.

would appear that adequate amounts of heparin e effective in preventing the accumulation of platelet asses on the injured surfaces of veins.

The opinion has been wide-spread, however, proba- y largely as a result of a publication of Shionoya, at while heparin prevents the clotting process it es not influence the deposition of platelets. Rown- ee and Shionoya[2] studied the accumulation of plate- ts in an "extracorporeal loop." Using this technique, hionoya[3] reported that heparin had no influence upon e rate of formation of white thrombi.

We have repeated the experiments of Shionoya and nd that in dogs when the observations are made over two- or three-hour period, there is almost invariably ormation of whi'e thrombi in the glass cannulae and e collodion or Cellophane tube used to connect the rterial with the venous cannula. Masses of white rombi, large enough to produce partial or complete bstruction of the tubes, have been observed in 15 of e 16 experiments in which no heparin was used. In xperiments, however, in which one intravenous injec- on of a solution of purified heparin (450 units per ilogram) was made, we have never observed any bstruction of blood flow or the accumulation of any latelet masses.

Microscopic examination of the obstructing masses the experiments in which heparin was not used evealed, in every case, the typical structure of the hite thrombus. In all except two of the experiments which heparin was used microscopic examination of he Cellophane loop revealed only a few red and white lood cells. In two cases *very minute patches* of mate- ial which appeared to be composed of platelets were een. It may be stated, however, that in no case was ny mass which had the characteristic structure of a hrombus observed in the experiments in which eparin was administered.

The results of these studies demonstrate that purified eparin is very effective in preventing the formation f white thrombi under the conditions of our experi- ents.

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LIGHT AND THE SEXUAL CYCLE OF GAME BIRDS

Since Rowan's[1] original observations that lengthening the period of light in winter by means of artificial illumination caused stimulation of normally quiescent gonads in juncoes, similar results have been found in other species of birds and some mammals.

As a result of night lighting of upland game birds, Petty[2] secured gonad stimulation and eggs in quail during the non-breeding season in 1934, Martin[3] announced mid-winter production of eggs in pheasants (*Phasianus colchicus torquatus*) in 1935, Clark, Leonard and Bump[4] secured gonad stimulation in pheasants, quail and grouse (*Bonasa umbellus*) and Bissonnette and Csech[5] secured early eggs from pheasants and quail by night lighting.

We wish to report briefly some of our experiments concerning the factors regulating sexual activity in the pheasant and grouse.

(1) The absence of light inhibits the onset of sexual activity in the grouse and pheasant. Two pair of grouse were continuously in the dark, except for a low illumination of 0.02 foot candles over the feeder from February 10 to June 20, 1936. No sexual activity was manifested during this time, although the experiment extended over the period of sexual activity of the control birds. Two pair of pheasants under the same experimental conditions also failed to come into breeding.

(2) Continuous illumination during the winter months can stimulate grouse into sexual activity and egg laying but does not prevent the cessation of egg laying. A pair of grouse were illuminated continuously, starting on February 10, by two 150 watt lamps. No daylight was admitted and the light intensity was maintained constantly at 22 foot candles. Egg laying began on March 6 and continued to April 3, yielding 14 eggs, the normal number for grouse. None of the control grouse laid before April 10. The experimental birds ceased laying in spite of the continued light. We were able to secure egg production prematurely in pheasants and quail with night light, but did not carry the experiment to the end of the normal breeding season.

(3) The cessation of egg laying is probably due to a failure of the hypophysis to furnish the necessary gonad stimulating hormones rather than to an exhaustion of the gonads. On June 23, 1936, two pair of grouse which had completed their reproductive cycle were autopsied, and it was found that the sex organs had regressed to approximately the mid-winter condition. The testes of the males weighed 41.4 and 41.6

[2] L. G. Rowntree and T. Shionoya, *Jour. Exper. Med.*, 46: 7, 1927.
[3] T. Shionoya, *Jour. Exper. Med.*, 46: 19, 1927.
[1] W. Rowan, *Nature* (London), 115: 494–495, 1925.

[2] *American Field*, August 11, 1934.
[3] L. E. Martin, *Game Breeder and Sportsman*, 39: 95, April, 1935.
[4] L. B. Clark, S. L. Leonard and G. Bump, Science, 83: 2150, 268, March 13, 1936.
[5] T. H. Bissonnette and A. G. Csech, Science, 83: 2156, 392, April 24, 1936.

mgs, as compared to 27.3 mg for the testes of a male autopsied in January of the same year. The ovaries weighed 126.8 and 110.3 mgs, as compared to 56.7 mg for the ovaries of a bird killed in mid-winter. The injections of 5 to 10 grams equivalent of an alkaline hypophyseal[6] extract in 3 male grouse for 10 days resulted in testes weighing 238.2, 206.4 and 179.4 mgs, an increase of approximately five times.

Similar results were found in the pheasants. The testes of 3 male pheasants autopsied on August 3, 1936, three weeks after the close of the breeding season, weighed 367.8, 617.1 and 612.5 mgs. The testes of birds in the winter weighed from 69.7 to 164 mgs, while in full sexual activity they weighed over 6 grams. Three male pheasants, each receiving a pyridine extract of sheep hypophysis equivalent to 5 grams of dried glands for a period of 10 days, yielded testes weighing 1,232, 2,209 and 3,001 mgs, as compared to 907 and 1,052 mgs for two uninjected controls. The difference in weight of the testes of the controls and those autopsied August 3 is due to the fact that they belong to different age groups. The average increase was 119 per cent.

In both grouse and pheasant, histological examination of the testes confirmed the gross observations. In all injected birds, the testes showed mitotic activity, an increase in the number of cells in the germinal epithelium and an enlargement of the tubules. Normal sperm were found in the largest testes of the injected pheasant; none were found in the controls. The control testes of both pheasant and grouse gave evidence of degenerating to the resting condition, the grouse testis having regressed further.

(4) The gonads of immature pheasants will respo to adequate hypophyseal stimulation. A group 8-week-old male pheasants were given a simil amount of the sheep hypophyseal extract for the sa period as the adult pheasants. The testes of t young injected birds weighed 197.0, 143.3 and 93. mgs, and the testes of the controls weighed 61.2, 45. and 67.8 mgs, an average increase of 148 per ce Microscopically, the stimulated testes were easily di tinguished by the enlargement of the tubules and t increased number of division figures in the germin epithelium.

SUMMARY

The results of these experiments has led us to co clude that light is a primary factor in inducing sexu activity in pheasants, quail and grouse, through t mediation of the hypophysis. Once this hypophyseal gonad reaction is started it can not continue indefi nitely with adequate light but only until the hypoph ysis falters in the production of the gonad-stimulatin hormone through causes unknown. The immatur pheasant resembles the adult at the close of the breed ing season in that the gonads are capable of respond ing to adequate hypophyseal stimulation.[7]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE PHOTOELECTRIC DETERMINATION OF PHOSPHORUS IN ESTUARINE WATERS

IN estuarine waters there is much variation in salinity and heavy metal content, both of which factors may interfere with phosphorus determination, when the Denigès method is followed. Errors due to such factors must be taken into consideration. Also, the blue color of the reduced phospho-molybdate, as produced in the Denigès method, may be of improper magnitude (intensity and quality) for comparison with a standard blue solution by means of an ordinary comparison colorimeter. Accordingly, a photoelectric colorimeter was devised to study the color production.

A Weston photometer measuring light intensity in foot candles, a ruby glass filter, a pyrex tube 30 cm long closed at both ends to hold the solution and a Spencer microscope lamp served as the photoelectri colorimeter. The solution to be tested, which was blu in color after being treated according to the Denig method, was put into the 30 cm pyrex tube, in th ends of which plane glass pyrex windows were fused An opening left on the side of the tube served fo filling and emptying. By placing such a cylinder, fille with the blue solution to be tested, in the path of th beam of light, the absorption of the light by the solu tion expressed in terms of change in light intensity would be measured by the galvanometer of a light-sensitive instrument, such as the Weston photometer at the other end. The ruby glass filter which trans mitted only a narrow band of red (an average wave length of 6,500 Å) was used because in the region o the band mentioned there was a maximum change in

[6] Acknowledgment is made to Parke Davis Company for their kindness in furnishing the hypophyseal glands.

[7] Research supported in part by assistance of grant-in-aid of the Society of Sigma Xi and the Rockefeller Foundation.

ght transmission with the changing concentration of ne coloring matter and hence maximum sensitivity. riefly, the purpose was to measure light intensity in at region of the spectrum where the greatest changes magnitude occurred, irrespective of the color.[1]

From the data obtained by this method, calibration rves for the salinities ranging from 0 o/oo to 30 o/oo 30 gms of salts per 1,000 ml of water) with 5 o/oo crements were constructed. An artificial sea water ggested by Büch was used, in which NaCl, K_2SO_4 d $MgCl_2$ of the highest purity (almost free from hosphorus) were dissolved in water redistilled in a yrex still. Such water was practically free from hosphorus. Pure KH_2PO_4 was added to these solu-ons to make them of concentrations of phosphorus nging from 0 mg P/m³ to 100 mg P/m³ (100 milli-rams of phosphorus per cubic meter of water).

Calibration curves, which deviated only slightly rom straight lines, were made by plotting as ordi-ates the logarithm of the photometer reading on emi-log paper, against the concentration of phos-horus in milligrams per cubic meter as abscissae. y observing the point on the calibration curve corre-ponding to the photometer reading obtained for a est, the phosphorus content may be read off on the bscissa. Such curves have been found satisfactory, ecause known amounts of phosphorus added to the est solution have been recovered with small error, ndicating that the curve and method are satisfactory nd reasonably accurate. Table 1 shows the recovery

TABLE 1

Inorganic phosphorus present in water sample	Inorganic phosphorus added	Total inorganic phosphorus expected	Total inorganic phosphorus recovered
mg P/m³	mg P/m³	mg P/m³	mg P/m³
18	0	18	18
18	10	28	28
18	20	38	40
18	30	48	50
18	80	98	96
9	0	9	9
9	10	19	18
9	20	29	30
9	30	39	39
9	80	89	94

f added phosphorus, in milligrams per cubic meter, rom Chesapeake Bay water of an approximate salin-ty of 15 o/oo (first group of figures) and from the ame water diluted one half with redistilled water second group of figures). Due to the use of the uby glass filter the sensitivity and accuracy of the ethod were greatly increased, especially in the lower oncentrations of phosphorus, as can be seen from the fact that one milligram of phosphorus corresponds to forty divisions on the photometer scale.

The question of the effect of salts on color production needs consideration, since the samples to be tested are saline solutions. A study of the curve for redistilled water as compared with the curves for artificial sea water shows the former to have a steeper slope than the latter, which means that the salts in the water decrease the amount of color. The slope of the curves for artificial sea water were found to decrease a little for the salinities studied, *i.e.*, from 5 o/oo to 30 o/oo. This shows that for the salinities of 5 o/oo to 30 o/oo the effect of the salts on the color production is small, *i.e.*, there is only a small increasing effect with the increasing salinity in the range tested. In fact, an average curve for salinity from 5 o/oo to 30 o/oo and phosphorus content from 0 to 100 milligrams per cubic meter has given results accurate enough for our purposes. But the salt effect or decrease in color due to the presence of salts is considerable when compared with the color in redistilled water. This is readily seen from the curves (see Fig. 1).

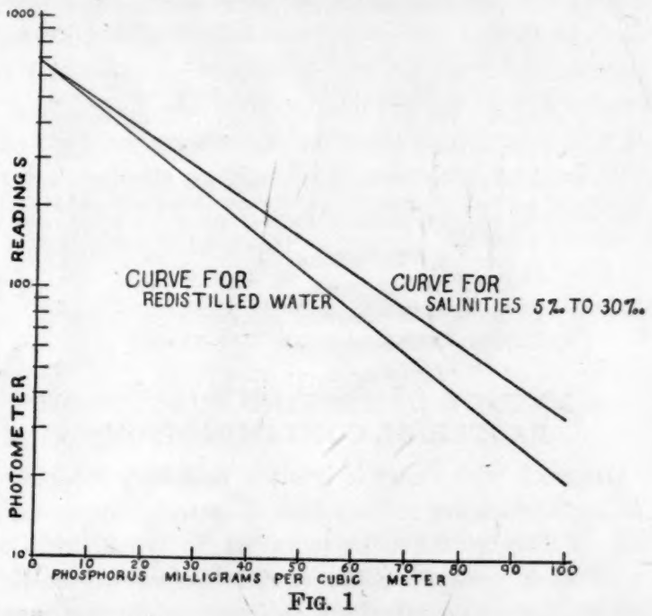

FIG. 1

It was suspected that copper and iron salts have an effect on color production. Accordingly, copper as $CuSO_4$ and iron as $FeSO_4$ and $Fe_2(SO_4)_3$ were added in varying amounts in a series of tests. The amounts of each metal added were such as might be found in estuarine waters, but each series was extended beyond this so as to increase the amount four or five times, thus covering any possible range that might be encountered. The effect of copper and iron on color production was negligible in redistilled water as well as in the various salinities of artificial sea water tested. The interfering effects of silica are prevented in our tests by the high acidity of molybdate sulfuric reagent used in the Denigès method.

While there is a salt effect no corrections need be

[1] In this investigation the authors are pleased to acknowledge the aid given by Professor A. H. Pfund, of the Department of Physics in Johns Hopkins University, in the solution of problems of light absorption.

made for salinity and other interfering substances if calibration curves are used because these interfering factors with one exception, that of arsenic, are taken care of in the preparation of the curves. Arsenic, if present as arsenate, and phosphorus are determined together in the Denigès method, so it is necessary to evaluate the arsenate by suitable means if true phosphorus values are to be obtained.

Farber and Youngberg[2] have shown that with the Denigès[3] method, copper, iron and sulfates do not interfere with the color production in phosphorus determinations if appropriate amounts of reagents are used. Cooper[4] has recognized that there is an interfering effect of the salts present in sea water. Brujewicz[5] gives tables of correction for various salinities, showing that the latter have an effect on color production, and he evaluates a corresponding factor. Kalle,[6] on the other hand, maintains that in the true sense of the word there is no salt error, but that the effect obtained is due rather to the copper present in the sea water. Using the same instrument as Kalle, Robinson and Wirth[7] found a decided decrease in color intensity due to the presence of salts. Our results show that there is decided salt effect from redistilled water to a salinity of 5 o/oo, but that this effect increases only a small amount from this point to 30 o/oo salinity. Also, in agreement with Farber and Youngberg, copper and iron in the magnitudes tested have no effect on color production.

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A METHOD OF FREEING FUNGI FROM BACTERIAL CONTAMINATION[1]

IN work with fungi it is often necessary to obtain cultures which are entirely free of bacterial contamination. This problem presents particular difficulties with such groups as the aquatic Phycomycetes, in which the whole mycelium is immersed in water or culture medium. Several methods have been described to secure bacteria-free material of such forms, but many of them rely on complicated apparatus, difficult technique or long and time-consuming procedure. The following method, requiring a minimum of effort and time, has been used successfully to free a number of water molds from their bacterial contaminants.

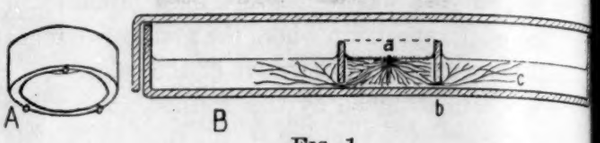

FIG. 1

To one end of a Van Teighem ring are fused three small glass beads, one third to one half mm in diameter, as shown in A of the accompanying diagram. The ring is placed in a Petri dish with the beaded surface resting on the bottom of the dish. Into the Petri dish enough nutrient agar (2 per cent. agar plus some suitable nutrient) is poured to bring its surface well up on the sides of the ring as in B. After the agar has solidified, a bit of inoculum is transferred to the area within the ring (*a*). As growth takes place some of the hyphae extend down into the agar, grow under the ring (b) and into the agar lying beyond it; the contaminating bacteria, however, do not follow the hyphae but are retained at the surface of the semi-solid within the ring. Cubes of agar containing numerous hyphal tips from this outlying portion of the mycelium (c) are therefore bacteria free; from these it is simple to start fresh cultures perfectly free from contamination.

This method has been used so far only for the purpose of freeing water molds from bacteria, but it should prove equally effective in securing pure cultures of any fungus which does not form an aerial mycelium. It is described here in the hope that it may be of use to other students working with such forms.

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